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# A TEST FACILITY FOR 6000 HOUR LIFE TEST OF A 30 CM MERCURY ION THRUSTER

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Electrical propulsion engines for extended space missions require test periods comparable to the intended flight time in order to demonstrate satisfactory long-term performance. This is because the operation of these devices is typically optimized at some specific design point, and hence accelerated testing during a life test is not possible. The facility must provide an adequate environment for the thruster with maximum reliability at minimum initial and operating cost.

Some features of the test facility can be made to adequately simulate the ultimate space environment. Those which cannot must be controlled to the extent that damage to the thruster is prevented and thruster performance is not degraded or obscured.

In 6000 hours a 30 cm mercury ion thruster operating at 1.5 amperes ejects approximately 78 kg of propellant which will erode a significant amount of collector material. Accordingly, collector design must consider durability, contamination of the thruster or facility by erosion products, and dissipation of beam power. A frozen mercury collector was chosen because 1) erosion products are compatible with the thruster, 2) beam power is readily dissipated, and 3) eroded mercury which collects on shroud walls can be returned to the collector by warming the shrouds, thereby providing the required durability.

The thruster was mounted at the top of a vertical axis space chamber with the ion beam projecting downward 160 inches into a liquid nitrogen cooled collector which is 100 inches in diameter containing 2120 kg of mercury. Two cylindrical liquid nitrogen cooled shrouds are provided between thruster and collector to ensure that the ion beam can see only mercury covered surfaces.

Three view ports and two axis adjustable internal lighting have been provided to permit viewing and photographing of collector, shrouds, and thruster for assessing erosion, beam profile estimation, etc. Beam density distribution at two positions on the axis can be measured by the probes inserted through glands. Propellant and neutralizer mercury flow metering is accomplished by a weighing system.

The life test facility is provided with chamber operation, thruster operation, and personnel safety detection monitoring equipment which permits unattended operation. Any malfunction of the facility is indicated at a 24 hour guard station by a two digit number which identifies the difficulty and action required to correct the malfunction.

Thruster operating parameters are measured hourly by an automatic data collection system which may be locally or remotely interrogated for stored or real time data. A computer program for automatic operational parameter scanning and data acquisition is being implemented.